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A METHOD OF DETERMINING GREASE AND DIRT IN WOOL.

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OBJECT OF THIS INVESTIGATION.

The object of the wool-scouring investigation here discussed is to afford a fair basis for comparing the grease and dirt indices of various wools, the indices to be used to divide wools into groups for the study of other qualities affected by or associated with grease and dirt contents, such as length of fiber, fineness, density of fleece, spinning quality, strength, and weight of clean wool per fleece. Data obtained are to be used in planning the mating of the sheep that grow the fleeces studied for the purpose of fleece improvement in the qualities mentioned.

METHOD OF OBTAINING DATA.

Sheep-breeding investigations conducted by the Bureau of Animal Industry, United States Department of Agriculture, involve extensive studies in fleece improvement. Individual fleeces of about 2,000 sheep are studied each year, and the problem of obtaining data on the net yield of clean wool from each fleece has prompted the development of a method of single-fleece determination that would yield dependable results without necessitating the complete

[1] Moisture experiments reported in this bulletin were conducted by J. I. Hardy during the winter of 1919 and 1920. Doctor Hardy resigned from the department in February, 1920.

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scouring of all the wool. Separate determinations of the grease and dirt content of each fleece furnish information of great usefulness for sheep-breeding studies in connection with their application to wool improvement, but the expense of separate determinations for so large a number of fleeces creates the necessity for working with samples instead of scouring entire fleeces. A sample weighing approximately 1 pound is therefore taken from the side of each fleece at the time the sheep are sheared. These samples are then sent direct to the Bureau of Animal Industry wool laboratory, near Beltsville, Md., and stored in a dry room until they are used in the

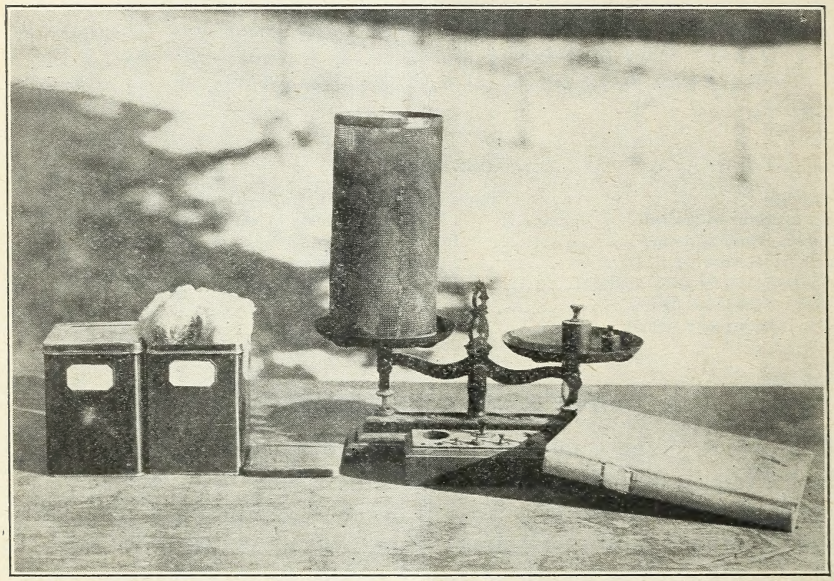

FIG. 1.—Wool containers, balance, and record book. The closed container shows the can of raw wool ready for shipping and storing at the wool laboratory, Beltsville, Md. Upon preparing the wool for scouring, the container is opened and the wool is placed in the basket shown on the balance. A sample sheet of the data kept in the record book is shown in Table 7.

scouring test. Most of the fleeces studied to date have been grown on the bureau's experimental range sheep at the United States sheep experiment station, near Dubois, Idaho, although fleeces grown at the bureau's farm sheep stations near Beltsville, Md., and Middlebury, Vt., are also being sampled for use in this investigation.

EXPERIMENTAL WORK.

INDEX FIGURES FOR GREASE AND DIRT.

Specially designed apparatus has been constructed to remove the grease by the use of gasoline, without loss of dirt, and later in another apparatus the wool is washed to remove all the dirt.

Approximately 250 grams of each sample of wool as it comes from the storage room are used for the scouring test. The sam-

ples are placed in wire-mesh baskets (see Fig. 1) and brought to a constant-moisture content[2] by drying in an oven. After heating at 50° C. for three hours in this conditioning oven they are weighed with a delicate balance. (See Fig. 2.)

The samples are then placed in extraction containers and washed with deodorized gasoline (gas-engine gasoline) such as is used in canning factories. After the gasoline is put on the samples they are agitated up and down in the container 10 times and are allowed to stand for 45 minutes, after which the gasoline is allowed to filter through 13-inch filter papers. After all the gasoline is filtered,

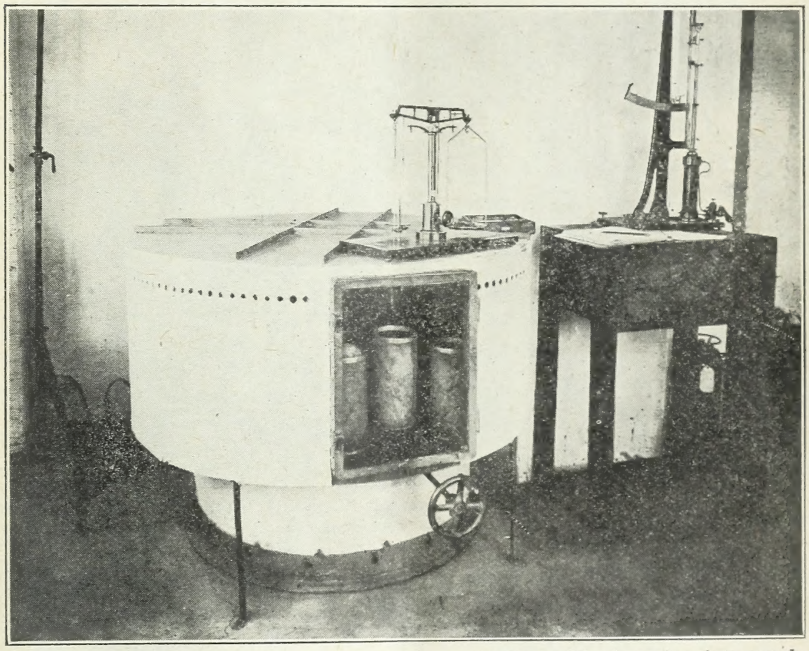

FIG. 2.—Conditioning oven. Note method of weighing wool baskets without opening glass oven door. Baskets are brought into position for weighing by turning the wheel shown below and in front of the oven. When in position the basket is hooked on to the weighing apparatus.

the filter paper containing the dirt is folded and placed with the sample. Clean filter papers are then placed under the extraction containers, and a second gasoline washing is given the wool samples. The same filter papers are used for the second and third extractions. After three gasoline extractions the remaining filter papers are also placed with their respective samples and the wool is again brought to air-dry condition. (See Figs. 3 and 4.) When it is necessary to save time the samples are placed in a blower-dryer to speed up this operation. (See A, Fig. 4, also C, D, and E, Fig. 5.) Drying for one hour in the blower-dryer and standing in the open at room temperature for 15 minutes brings the samples to an air-dry

[2] "Constant-moisture content," as used here, allows for a slight variation but is insufficient to affect the results appreciably.

condition. The samples are again dried, at 50° C. for three hours, and weighed.

The samples are next washed with soap and water at a temperature of from 40° to 45° C. for three-quarters of an hour. (See Fig. 5.) About one-half pound of neutral soap is placed in the first vat containing 150 gallons of water. After washing the samples, the water is squeezed from them and they are placed in a second vat and washed for half an hour in clear water at a temperature of from 40° to 45° C. When washing extremely dirty wool, one-quarter of a pound of neutral soap is added to the 150 gallons of water in the

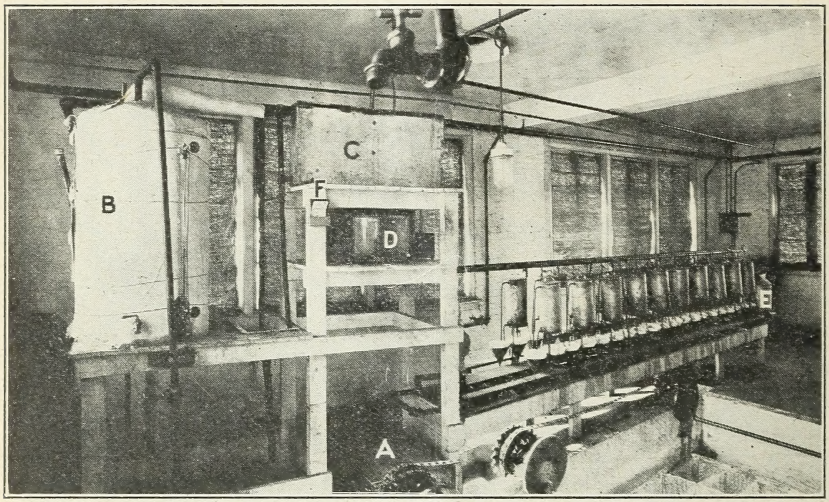

FIG. 3.—Grease extraction apparatus. Extraction containers are shown in the right half of this illustration, with filter papers beneath. The baskets of wool are placed in these containers and gasoline is poured into the containers until within 2 inches of the top. Lids are placed on the containers after the agitating process, and the gasoline is allowed to stand 45 minutes. Upon filtering, the gasoline returns to the pressure tank, A. It is then forced into the distillation tank, B, condensed in tank, C, and returned through the collecting tank, D, and the upper pipes into can, E. At F is shown the card file bearing the weekly schedule of work. A card is used for each day's program. This schedule is shown in full on page 17.

second vat and the wool is again washed for 30 minutes, but soap is not used in the second vat unless the wool is extremely dirty. In case soap has been used in the second vat the water is squeezed from the wool and it is washed a third time in clear water at the same temperature. After the samples have been washed in one clear water for 30 minutes the water is squeezed from them by the use of a wringer; they are put into the original containers and dried in the blower-dryer at 60° C. for eight hours, allowed to stand overnight, and conditioned in the conditioning oven for three hours. The weight of the grease is found by the difference in the weight of conditioned, greasy wool and the conditioned weight of the sample after three washings with gasoline. Likewise the weight of the dirt is found by the difference in the weight of the conditioned wool

after washing with gasoline and the weight of the same conditioned wool after washing with soap and water.

BASIS OF THE INDEX FIGURES.

A difference in dirt content of raw wool would cause a difference in the percentage weight of grease and clean wool in samples that

FIG. 4.—Degreased wool airing after three treatments of gasoline. The two large cans in the foreground are shown collecting the gasoline returned from the gasoline still in the rear. Air pipe, A, connects lower and upper parts of blower dryer used for drying wool after washing.

are similar except that one is of lower dirt content than the other. Likewise, a difference in grease content would cause a realignment of percentage figures. In order, therefore, to obtain a fair and constant basis for indices of grease and dirt, the actual weight of each of these materials removed is considered in its relation to the

final weight of clean wool found in the sample. For example, the grease index is calculated by the following formula:

$$\frac{100 \times \text{weight of grease}}{\text{weight of clean wool}}.$$

CONDITIONING FOR WEIGHING.

The foregoing outline shows the need of three weighings of each sample. It often happens that different classes of wools may be handled at the same time and similar wools may be worked with on days varying widely as to temperature and moisture. In order to get useful data from the determinations made throughout the year and with different wools, it is necessary to condition the wools for each weighing in such way as to overcome the effect upon the results of differences in natural moisture or of moisture contents as affected by varying air conditions. Two samples of wool might contain quite different quantities of moisture, due to their contents of grease and foreign matter. The index figures would be based upon final weight of clean wool. This index might be rendered incorrect to the extent of 0.03 per cent in case conditioning was not sufficient to bring these samples to a uniform moisture content, for example:

Sample A under natural conditions in air contains—

	Grams.
Moisture	15
Grease	20
Dirt	40
Clean wool	25
Total weight	100

Sample B has similar amounts of grease and clean wool, but 45 per cent of its weight in dirt and only 10 per cent moisture. The true composition is then as follows:

	Grams.
Moisture	10
Grease	20
Dirt	45
Clean wool	25
Total weight	100

Results of tests shown in Table 2–*c* indicate that imperfect conditioning might remove 60 per cent of the moisture from sample A and only 50 per cent from sample B. Calculation of the grease index on this basis would therefore result as follows:

Sample A, 60 per cent of 15 grams moisture removed equals 9 grams, leaving a remainder of 6 grams.

	Grams.
Moisture	6
Grease	20
Dirt	40
Clean wool	25
Total weight of conditioned sample	91

One hundred grams of such conditioned wool would have:

	Grams.
Moisture	$\frac{100\times 6}{91}=6.59$
Grease	$\frac{100\times 20}{91}=21.98$
Dirt	$\frac{100\times 40}{91}=43.96$
Clean wool	$\frac{100\times 25}{91}=27.47$
Total	100

$$100\times\frac{21.98\text{ (grams of grease)}}{27.47\text{ (grams of clean wool)}}=80.01\text{, grease index.}$$

Sample B, 50 per cent of 10 grams moisture removed equals 5 grams, leaving a remainder of 5 grams.

	Grams.
Moisture	5
Grease	20
Dirt	45
Clean wool	25
Total weight of conditioned wool	95

One hundred grams of such conditioned wool would have—

	Grams.
Moisture	$\frac{100\times 5}{95}=5.26$
Grease	$\frac{100\times 20}{95}=21.05$
Dirt	$\frac{100\times 45}{95}=47.37$
Clean wool	$\frac{100\times 25}{95}=26.32$
Total	100

$$100\times\frac{21.05\text{ (grams of grease)}}{26.32\text{ (grams of clean wool)}}=79.98\text{, grease index.}$$

Even though there is a difference of 5 per cent in the moisture of sample A as compared with sample B, the grease index is not changed appreciably, the difference here shown being $80.01-79.98=0.03$.

Table 1 shows results from nine samples, A-1 to A-9. The air-dry weights of these samples were taken on a comparatively dry day and conditioned for three hours at 50° C. These same samples were exposed in a moist room and again conditioned for three hours at 50° C. They are designated in the table as B-1 to B-9. All weights are given in terms of grams.

TABLE 1.—*Comparison of effects of dry weather and wet weather on conditioning of wool.*

Sample.	A.		B.		Difference between conditioned weights A and B. Per cent based on conditioned "A" samples.	
	Dry-day air weight.	After 3 hours at 50° C.	Wet-day air weight.	After 3 hours at 50° C.		
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per cent.*
1	272.5	263.5	284.9	266.2	2.7	1.01
2	272.8	262.0	283.4	263.2	1.2	.45
3	271.1	259.7	282.0	261.6	1.9	.72
4	273.3	262.8	283.9	264.9	2.1	.79
5	274.0	262.3	282.6	261.3	−1.0	− .38
6	303.0	291.1	311.8	291.3	0.2	.06
7	272.0	262.5	282.7	263.5	1.0	.38
8	269.7	259.1	278.5	259.2	0.1	.038
9	277.5	266.0	286.8	266.6	0.6	.22

There is a maximum difference of 2.7 grams, or 1.01 per cent, in the moisture of samples A and B after three hours' conditioning. According to calculations of grease indices for samples A and B, which are shown just preceding Table 1, this difference is not large enough to affect seriously the figures for grease index.

Table 2 shows the results of conditioning wool for different lengths of time and gives comparisons of the effect of conditioning wool at 50° C. as compared with conditioning at 100° C. Comparison of the weights of samples after four hours' drying at 100° C. with the weights of the same samples after five hours' drying at 100° C. shows that the extra hour resulted in a very small loss in weight. It is, therefore, assumed that the weight of the samples after five hours' drying at 100° C. shows the lowest weight that may be obtained by driving off moisture. In other words, weights of the samples after heating five hours at 100° C. are considered moisture-free, and the difference between these weights and the original air-dry weights represents the moisture contained in the air-dry samples, and this figure is used as the basis for calculating the percentage of moisture lost.

TABLE 2.—*Results of conditioning wool samples.*

a. WEIGHTS OF WOOL SAMPLES.

Grade of sample.	Sample No.	Air-dry.	Dried at 50° C.			Dried at 100° C.		
			End first hour.	End second hour.	End third hour.	End third hour.	End fourth hour.	End fifth hour.
		Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Idaho fine medium	10	207.9	196.3	190.7	188.0	174.96	170.78	168.10
Delaine	11	152.1	143.5	140.5	139.2	133.63	132.17	131.15
Do	12	203.1	193.7	187.5	187.7	180.16	177.54	175.61
Idaho fine medium, very dirty	15	211.7	199.6	195.1	192.5	177.52	176.57	174.47
Do	17	212.0	199.6	195.0	192.6	180.52	179.12	177.49

b. WEIGHT OF MOISTURE LOST.

Idaho fine medium	10	207.9	11.6	17.2	19.9	32.94	37.12	39.8
Delaine	11	152.1	8.6	11.6	12.9	18.47	19.93	20.95
Do	12	203.1	9.4	15.5	15.4	22.94	25.56	27.49
Idaho fine medium, very dirty	15	211.7	12.1	16.6	19.2	34.18	35.13	37.23
Do	17	212.0	12.4	17.0	19.4	31.48	32.88	34.51

TABLE 2.—*Results of conditioning wool samples*—Continued.

c. PER CENT OF MOISTURE LOST.

Grade of sample.	Sample No.	Dried at 50° C.			Dried at 100° C.		
		End first hour.	End second hour.	End third hour.	End third hour.	End fourth hour.	End fifth hour.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Idaho fine medium	10	29.15	43.22	50.00	82.76	93.27	100
Delaine	11	41.05	55.37	61.58	88.16	95.13	100
Do	12	34.19	56.38	56.02	83.44	92.97	100
Idaho fine medium, very dirty	15	32.50	44.59	51.57	91.81	94.36	100
Do	17	35.93	49.26	56.21	91.22	95.28	100

Table 2-*c* shows that conditioning for three hours at 50° C. removed from 50 per cent to 61.5 per cent of the moisture contained in the air-dry wool tested. The calculations previously shown for the theoretical cases of samples A and B are therefore in line with actual tests shown in Table 2. These results, therefore, form the basis for the decision that conditioning wool samples at 50° C. for three hours is sufficient to permit scouring experiments to be conducted within reasonable limits of error. As sufficient accuracy is possible by conditioning at 50° C. for three hours while moisture-free conditioning would require a great deal more time and expense, all samples used in the wool laboratory tests at Beltsville, Md., are conditioned for three hours at 50° C.

The same samples as were used for the tests reported in Table 1 were also dried at 80° C. and records kept of the percentages of loss in moisture at the end of each hour for a period of three hours. All percentages in regard to the less-moist samples are based on the air-dry weights of the less-moist samples, and all percentages in regard to the more-moist samples are based on the air-dry weights of the more-moist samples. The results of this experiment are given in Table 3.

TABLE 3.—*Wool samples with different amounts of moisture, weighed at end of each hour while drying for a period of three hours at 80° C.*

Sample.	Less-moist sample, air-dry weight.	More-moist sample, air-dry weight.	Less-moist sample, weight after 1 hour.	More-moist sample, weight after 1 hour.	Less-moist sample, per cent lost in moisture in 1 hour.	More-moist sample, per cent lost in moisture in 1 hour.	Less-moist sample, weight after 2 hours.	More-moist sample, weight after 2 hours.	Less-moist sample, per cent lost in moisture in 2 hours.	More-moist sample, per cent lost in moisture in 2 hours.	Less-moist sample, weight after 3 hours.	More-moist sample, weight after 3 hours.	Less-moist sample, per cent lost in moisture in 3 hours.	More-moist sample, per cent lost in moisture in 3 hours.
	Gms.	*Gms.*	*Gms.*	*Gms.*	*P. ct.*	*P. ct.*	*Gms.*	*Gms.*	*P. ct.*	*P. ct.*	*Gms.*	*Gms.*	*P. ct.*	*P. ct.*
1	267.3	285.4	257.7	268.7	3.59	5.85	251.7	260.7	5.83	8.65	248.4	257.7	7.07	9.71
2	267.7	282.5	258.3	267.1	3.51	5.45	252.7	260.2	5.60	7.89	249.7	255.5	6.72	9.56
3	269.6	284.1	259.3	269.2	3.82	5.24	254.7	262.4	5.52	7.63	251.8	257.8	6.60	9.25
4	269.2	282.7	260.0	268.3	3.41	5.09	254.6	261.7	5.42	7.43	251.6	257.2	6.53	9.02
5	267.8	283.6	257.5	266.8	3.84	5.92	252.1	259.5	5.86	8.49	249.3	254.9	6.96	10.12
6	267.2	282.6	255.5	264.3	4.37	6.47	249.5	256.2	6.62	9.34	246.7	252.0	7.67	10.82
7	265.9	281.0	253.5	262.9	4.66	6.44	248.9	255.6	6.39	9.04	245.7	250.8	7.59	10.74
8	268.9	282.3	257.5	266.1	4.23	5.73	252.7	259.5	6.02	8.07	250.8	255.4	6.73	9.52
9	269.3	284.0	257.4	265.8	4.41	6.40	252.3	259.1	6.31	8.77	249.1	254.7	7.50	10.31
Average	268.1	283.13	257.41	266.57	3.98	5.84	252.13	259.4	5.95	8.37	249.25	255.11	7.05	9.89

An analysis of Table 3 shows that the more-moist samples, air-dry, averaged 15.03 grams heavier than the same samples of wool when less moist and air dry, while the more-moist samples averaged only 5.88 grams heavier than the less-moist samples after conditioning three hours at 80° C. In other words, the average difference in weight due to moisture content was reduced by conditioning three hours at 80° C. to 39.1 per cent of the original difference between the more-moist samples air dry and the less-moisture samples air dry. It will also be noted that the more-moist samples consistently lost more moisture each hour during the conditioning process than was lost from the less-moist samples.

In like manner the same samples as were used in the tests reported in Table 3 were used to study the effects of conditioning at 50° C. The samples were weighed air-dry and dried at 50° C. for three hours and weighed at the end of each hour. The same samples were then allowed to take on more moisture and weighed again in a similar manner. All percentages in regard to both the less-moist and more-moist samples are based on the air-dry weight.

TABLE 4.—*Wool samples, with different amounts of moisture, weighed at the end of each hour while drying for a period of three hours at 50° C.*

Sample.	Less-moist sample, air-dry weight.	More-moist sample, air-dry weight.	Less-moist sample, weight after 1 hour.	More-moist sample, weight after 1 hour.	Less-moist sample, per cent lost in moisture in 1 hour.	More-moist sample, per cent lost in moisture in 1 hour.	Less-moist sample, weight after 2 hours.	More-moist sample, weight after 2 hours.	Less-moist sample, per cent lost in moisture in 2 hours.	More-moist sample, per cent lost in moisture in 2 hours.	Less-moist sample, weight after 3 hours.	More-moist sample, weight after 3 hours.	Less-moist sample, per cent lost in moisture in 3 hours.	More-moist sample, per cent lost in moisture in 3 hours.
	Gms.	*Gms.*	*Gms.*	*Gms.*	*P. ct.*	*P. ct.*	*Gms.*	*Gms.*	*P. ct.*	*P. ct.*	*Gms.*	*Gms.*	*P. ct.*	*P. ct.*
1	272.5	284.9	267.4	274.2	1.87	3.75	264.5	269.3	2.93	5.47	263.5	266.2	3.30	6.56
2	272.8	283.4	266.0	271.7	2.49	4.12	263.3	266.3	3.48	6.03	262.0	263.2	3.95	7.13
3	271.1	282.0	263.7	270.3	2.73	4.14	261.2	264.8	3.65	6.09	259.7	261.6	4.21	7.23
4	273.3	283.9	266.9	273.4	2.34	3.69	264.3	267.7	3.29	5.70	262.8	264.9	3.84	6.69
5	274.0	282.6	266.5	270.4	2.73	4.31	263.7	264.2	3.75	6.51	261.3	262.3	4.63	7.18
6	303.0	311.8	295.4	306.3	2.51	1.76	292.4	294.5	3.49	5.54	291.1	291.3	3.92	6.57
7	272.0	282.7	266.2	271.6	2.13	3.92	263.5	266.4	3.12	5.76	262.5	263.5	3.49	6.79
8	269.7	278.5	262.6	267.3	2.63	4.02	260.0	262.0	3.59	5.92	259.1	259.2	3.93	6.92
9	277.5	286.8	269.9	275.3	2.73	4.01	267.0	269.3	3.78	6.10	266.0	266.6	4.14	7.04
Average	276.2	286.28	269.4	275.61	2.46	3.72	266.65	269.38	3.45	5.90	265.33	266.53	3.93	6.90

The weights presented in Table 4 show that the more-moist samples, air-dry, averaged 10.08 grams heavier than when they were less moist but air dry. After conditioning for three hours at 50° C. there was an average difference of only 1.2 grams between the more-moist and less-moist samples. The conditioning for three hours at 50° C., therefore, resulted in reducing the difference in weight due to moisture so that at the end of the three hours the average difference was only 11.9 per cent as great as it was before conditioning. The final difference in the case of sample 8 was only 0.1 gram, which was the smallest difference found in this test, while the greatest

final difference was 2.7 grams in the case of sample 1. Using the air-dry weights of the less-moist samples as the basis for percentages, this difference of 2.7 grams amounts to only 0.99 per cent of the air-dry weight of the original sample, and the average difference of 1.2 grams is only 0.43 per cent of the average air-dry weight of the less-moist samples, while the smallest difference of 0.1 gram in the case of sample 8 amounts to only 0.037 per cent, all of which are negligible.

In view of the fact that these experiments showed no advantage in conditioning wool at a higher temperature, it was decided to condition samples at 50° C. The object is to obtain a basic or "conditional" weight, and on the basis of these experiments, 50° C. for three hours seemed to offer this condition when there is no more than 20 per cent of moisture in the air-dry samples. In the experiments here reported, 20 per cent moisture was the largest percentage for any of the samples used. Results of these experiments prove that the drying of wool samples containing no more than the usual amount of moisture for three hours at 50° C. is sufficient to remove all excess of moisture that would cause an appreciable error in the determination of grease, dirt, and clean-wool contents of raw wool.

DETERMINING WEIGHT OF GREASE.

The preceding discussion shows that in order to bring the samples to a constant-moisture content it is necessary to condition them three times before each of the three weighings in the process. It is equally important that all the grease be removed between the first and second conditionings in order to obtain the grease content distinct from the dirt.

The results of tests, involving a series of gasoline treatments on 20 Rambouillet and 20 crossbred[3] fleece samples (in which was shown the percentage of grease removed by each gasoline extraction until free from grease), form the basis for other tests to determine the exact number of treatments necessary to remove all grease. Table 5 shows the results from the 20 Rambouillet and the 20 crossbred wool samples.

[3] The crossbred sheep used in this investigation are the result of mating Rambouillet ewes with rams of coarse-wool breeds, and the interbreeding of such crosses; also sheep of the Corriedale breed.

TABLE 5.—*Grease removed by a series of gasoline treatments, conditioning between treatments.*

RAMBOUILLET FLEECE SAMPLES.

Sample No.	Conditioned weight of raw wool.	Cumulative weight of grease removed at each treatment (grams).				Cumulative per cent of grease removed at each treatment.				Per cent difference between 1st and 2d treatments.	Per cent difference between 2d and 3d treatments.	Per cent difference between 3d and 4th treatments.	Per cent total grease removed at —[1]		
		First.	Second.	Third.	Fourth.	First.	Second.	Third.	Fourth.				First.	Second.	Third.
2779	234.7	40.3	46.9	49.1	49.9	17.17	19.98	20.92	21.26	2.81	0.94	0.34	80.76	93.98	98.39
2826	230.1	36.2	42.7	44.7	44.7	15.73	18.55	19.42	19.42	2.82	.87	.00	80.98	95.52	100.00
2936	233.5	24.0	28.1	30.3	30.3	10.27	12.03	12.97	12.97	1.76	.94	.00	79.21	92.73	100.00
2968	234.2	36.6	41.5	43.6	44.0	15.62	17.71	18.61	18.78	2.09	.90	.17	83.18	94.31	99.09
2411	222.0	28.5	32.3	33.3	34.1	12.83	14.54	15.00	15.36	1.71	.46	.36	83.57	94.72	97.65
2474	232.9	49.6	56.8	59.4	59.5	21.29	24.38	25.50	25.54	3.09	1.12	.04	83.36	95.46	99.83
2698	232.1	35.9	40.8	42.9	43.2	15.46	17.57	18.48	18.61	2.11	.91	.13	83.1	94.44	99.31
3137	231.6	28.8	33.7	35.7	35.9	12.43	14.55	15.41	15.5	2.12	.86	.09	80.22	93.87	99.44
2136	237.8	37.7	42.9	44.7	44.7	15.85	18.04	18.79	18.79	2.19	.75	.00	84.34	95.97	100.00
2147	228.4	38.2	44.4	46.5	46.8	16.72	19.43	20.35	20.49	2.71	.92	.14	81.62	94.87	99.35
2151	232.4	33.3	38.6	39.4	39.5	14.32	16.61	16.95	16.99	2.29	.34	.04	84.3	97.72	99.74
2747	234.6	31.4	36.4	38.3	38.4	13.38	15.51	16.32	16.36	2.13	.81	.04	81.77	94.79	99.73
1656	229.1	32.3	37.3	39.1	[3]38.7	14.09	16.28	17.06	[2]16.89	2.19	.78	[2]— .17	83.46	96.38	[2]101.03
1779	239.3	43.5	49.6	51.4	51.7	18.17	20.72	21.47	21.6	2.55	.75	.13	84.13	95.93	99.41
1824	236.3	36.7	42.4	44.5	[4]44.5	15.53	17.94	18.83	18.83	2.41	.89	.00	82.47	95.28	100.00
1875	218.3	27.2	31.5	33.6	[3]33.2	12.45	14.42	15.39	[2]15.21	1.97	.97	[2]— .18	81.92	94.87	[2]101.20
1216	235.1	34.5	39.9	41.2	[2]40.9	14.67	16.97	17.52	[2]17.39	2.30	.55	[2]— .13	84.35	97.55	[2]100.73
1240	228.8	33.3	37.8	39.5	39.6	14.55	16.52	17.26	17.31	1.97	.74	.05	84.09	95.45	99.74
1251	229.0	32.5	37.4	39.2	39.2	14.19	16.33	17.11	17.11	2.14	.78	.00	82.91	95.41	100.00
1284	237.4	37.3	41.8	43.5	[2]43.0	15.71	17.61	18.32	[2]18.11	1.9	.71	[2]— .21	86.74	97.21	[2]101.16
Average	231.9	34.9	40.1	42.0	42.1	15.04	17.31	18.11	18.15	2.27	.80	.04	82.89	95.36	99.77

CROSSBRED FLEECE SAMPLES.

A-227	240.2	31.8	33.9	37.5	37.6	13.23	14.11	15.15	15.65	0.88	1.04	0.50	84.57	90.15	99.73
A-287	247.4	35.7	38.3	41.9	42.6	14.43	15.48	16.93	17.21	1.05	1.45	.28	83.80	89.91	98.35
A-364	244.3	31.6	33.9	37.6	38.4	12.93	13.87	15.39	15.71	.94	1.52	.32	82.29	88.28	97.91
A-440	246.0	29.3	31.3	36.5	36.6	11.91	12.72	14.83	14.87	.81	2.11	.04	80.05	85.51	99.72
B-742	240.7	26.5	27.4	31.8	32.4	11.01	11.38	13.21	13.46	.37	1.83	.25	81.79	84.56	98.14
B-799	239.6	28.5	31.1	35.2	35.6	11.89	12.97	14.69	14.85	1.08	1.72	.16	80.05	87.35	98.87
B-887	239.9	25.3	27.5	32.4	32.6	10.54	11.46	13.51	13.58	.92	2.05	.07	77.61	84.35	99.38
Lcn. 211	242.0	38.8	44.2	46.4	47.6	16.03	18.26	19.17	19.66	2.23	.91	.49	81.51	92.85	97.47
Lcn. 244	238.0	29.1	31.4	35.6	36.2	12.22	13.19	14.95	15.21	.97	1.76	.26	80.38	86.74	98.34
Lcn. 460	249.2	26.5	29.2	33.7	34.0	10.63	11.71	13.52	13.64	1.08	1.81	.12	77.94	85.88	99.11
Lcn. 511	240.1	21.1	22.4	26.6	27.2	8.78	9.32	11.07	11.32	.54	1.75	.25	77.57	82.35	97.79
Cla. 96	236.6	25.9	27.2	31.3	32.1	10.94	11.49	13.22	13.56	.55	1.73	.34	80.68	84.73	97.51
Cla. 101	239.8	34.9	39.4	44.1	45.7	14.55	16.43	18.39	19.05	1.88	1.96	.66	76.36	86.21	96.49
Cla. 112	241.0	25.3	29.0	33.2	35.1	10.49	12.03	13.77	14.56	1.54	1.74	.79	72.07	82.62	94.58
Cts. 63	241.2	17.9	19.5	21.0	23.6	7.42	8.08	8.71	9.78	.66	.63	1.07	75.84	82.62	88.98
C-260	243.5	18.7	20.7	24.6	25.2	7.67	8.50	10.10	10.34	.83	1.60	.24	74.21	82.14	97.61
D-188	243.7	24.3	27.2	30.4	30.9	9.97	11.16	12.47	12.67	1.19	1.31	.20	78.64	88.02	98.38
E-211	241.2	29.8	32.6	36.2	36.6	12.35	13.51	15.01	15.17	1.16	1.50	.16	81.42	89.07	98.91
O-94	245.0	42.0	45.7	49.8	50.3	17.14	18.65	20.32	20.53	1.51	1.67	.21	83.49	90.85	99.01
U.S. 168	248.6	43.6	47.8	50.9	51.8	17.53	19.22	20.47	20.83	1.69	1.25	.36	84.16	92.27	98.26
Average	242.4	29.3	32.0	35.8	36.6	12.09	13.19	14.78	15.10	1.10	1.59	.32	80.12	87.37	97.89

[1] In calculating the percentage of grease in the last three columns the amount of grease removed by 4 gasoline treatments is accepted as the total amount contained in the samples and is used as a basis, because the per cent of difference between the grease removed by the third and by the fourth treatment is shown to be negligible, the average being only 0.3.

[2] The weight of grease removed is determined by the subtraction of the conditioned weight of degreased wool from the conditioned weight of greasy wool. It is shown in the previous discussion that not all moisture is removed by conditioning. However, variation in moisture content of conditioned wool is not sufficient to cause appreciable error. Consequently slight errors caused by overweight due to moisture in the degreased samples occur at times but are not sufficient to affect the value of the final results.

The average results in Table 5 show that from the Rambouillet fleece samples the grease removed by one treatment was 15.04 per cent of the conditioned weight of raw wool; 17.31 by two; 18.11 by three; and 18.15 by four. The average results from the crossbred fleece samples were 12.09 per cent of grease removed by one treatment; 13.19

by two; 14.78 by three; and 15.10 by four. This indicates that after three treatments of gasoline the remaining grease is not sufficient to cause any appreciable error, there being only 0.04 per cent removed by the fourth treatment from the Rambouillet samples and 0.32 per cent from the crossbred.

The results of three other runs of 20 samples each of Rambouillets and crossbreds (based on the results of Table 5, which show that three is the least number of treatments which can be used) show in Table 6 the amount of grease removed by each extraction above the third until the samples are free from grease.

TABLE 6.—*Grease removed by gasoline treatments, conditioning after the third and after each succeeding treatment.*

RAMBOUILLET FLEECE SAMPLES.

Sample No.	Conditioned weight of raw wool. (grams).	Cumulative weight of grease removed at treatment (grams).		Cumulative per cent of grease removed at treatment.		Per cent grease removed by fourth treatment.	Per cent total grease removed by three treatments.
		Third.	Fourth.	Third.	Fourth.		
801	239.8	40.3	40.5	16.81	16.88	−0.07	99.51
U. S. 77	233.6	35.9	[1] 35.6	15.36	[1] 15.23	[1] −.13	[1] 100.84
1303	242.4	61.6	62.2	25.41	25.66	.25	99.03
1305	241.0	42.4	42.7	17.59	17.71	.12	99.29
2058	235.7	37.1	37.7	15.74	15.99	.25	98.41
2080	239.9	45.1	45.4	18.79	18.92	.13	99.33
2141	237.4	40.6	40.7	17.1	17.14	.04	99.75
2151	236.6	34.6	34.6	14.62	14.62	.00	100.00
2268	238.6	40.7	[1] 40.4	17.05	[1] 16.93	[1] −.12	[1] 100.74
2353	236.4	37.6	[1] 37.3	15.91	[1] 15.77	[1] −.14	[1] 100.80
2356	239.3	54.9	[1] 54.5	22.94	[1] 22.77	[1] −.17	[1] 100.73
2366	240.6	42.6	45.0	17.71	18.70	.99	94.66
2413	239.1	49.6	[1] 49.5	20.74	[1] 20.70	[1] −.04	[1] 100.20
2569	235.6	28.5	[1] 27.2	12.09	[1] 11.54	[1] −.55	[1] 104.77
2686	240.0	40.8	41.9	17.00	17.45	.45	97.37
2724	236.4	37.9	38.1	16.03	16.11	.08	99.47
2753	237.5	27.9	28.3	11.74	11.91	.17	98.58
2758	233.6	23.0	24.7	9.84	10.57	.73	93.11
2910	236.6	35.2	[1] 35.1	14.87	[1] 14.83	[1] −.04	[1] 100.28
2911	239.0	29.2	29.7	12.21	12.42	.21	98.31
588	239.5	44.3	45.4	18.49	18.95	.46	97.57
1101	239.6	32.1	32.6	13.39	13.61	.22	98.46
1125	242.9	42.3	43.3	17.41	17.82	.41	97.69
1201	236.7	44.5	46.5	18.80	19.64	.84	95.69
1350	239.8	51.7	53.7	21.55	22.39	.84	96.27
1387	244.2	44.0	45.1	18.01	18.46	.45	97.56
1850	236.2	34.7	35.8	14.69	15.15	.46	96.92
2360	240.4	46.8	48.0	19.46	19.96	.50	97.50
2410	237.1	40.5	42.2	17.08	17.79	.71	95.97
2434	237.1	29.3	30.5	12.35	12.86	.51	96.06
2470	239.2	34.2	35.2	14.29	14.71	.42	97.15
2471	236.7	41.0	41.3	17.32	17.44	.12	99.27
2582	234.5	28.1	[1] 28.0	11.98	[1] 11.94	[1] −.04	[1] 100.35
2643	254.2	47.3	47.8	18.61	18.80	.19	98.95
2666	239.3	37.3	37.9	15.58	15.83	.25	98.41
2819	239.2	53.7	54.0	22.44	22.57	.13	99.44
2931	235.1	26.1	26.2	11.10	11.14	.04	99.61
2937	235.3	35.1	[1] 35.0	14.91	[1] 14.87	[1] −.04	[1] 100.28
2999	234.6	28.5	[1] 28.4	12.14	12.11	[1] −.03	[1] 100.35
3137	230.4	30.3	[1] 30.2	13.15	13.11	[1] −.04	[1] 100.33
594	239.5	29.7	[1] 29.6	12.40	[1] 12.35	[1] −.05	[1] 100.33
1089	237.6	32.7	[1] 32.5	13.76	[1] 13.67	[1] −.09	[1] 100.61
1122	231.4	30.0	31.0	12.96	13.39	.43	96.77
1177	236.8	40.5	40.9	17.10	17.27	.17	99.02
1205	235.3	33.2	33.8	14.11	14.36	.25	98.22
1336	238.9	32.1	32.8	13.43	13.72	.29	97.86
1345	242.2	45.9	[1] 45.7	18.95	[1] 18.86	[1] −.09	[1] 100.43
1630	238.3	52.5	54.0	22.03	22.66	.63	97.22
1823	239.9	63.5	63.6	26.46	26.51	.05	99.84
2068	253.3	50.7	50.7	20.01	20.01	.00	100.00
2194	238.4	40.4	[1] 39.3	16.94	[1] 16.48	[1] −.46	[1] 102.79
2343	240.3	41.8	[1] 41.6	17.39	[1] 17.31	[1] −.08	[1] 100.48
2548	237.9	35.7	36.3	15.01	15.25	.24	98.34

[1] See footnote 2 under Table 5.

TABLE 6.—*Grease removed by gasoline treatments, conditioning after the third and after each succeeding treatment*—Continued.

RAMBOUILLET FLEECE SAMPLES—Continued.

Sample No.	Conditioned weight of raw wool (grams).	Cumulative weight of grease removed at treatment (grams).		Cumulative per cent of grease removed at treatment.		Per cent grease removed by fourth treatment.	Per cent total grease removed by three treatments.
		Third.	Fourth.	Third.	Fourth.		
2706	237.0	39.5	39.6	16.66	16.71	0.05	99.74
2713	237.2	32.9	32.9	13.87	13.87	.00	100.00
2754	235.7	41.7	42.2	17.69	17.90	.21	98.81
2956	227.5	37.5	37.5	16.48	16.48	.00	100.00
3015	241.5	54.6	54.7	22.61	22.65	.04	99.81
3073	244.2	46.3	[1] 45.9	18.95	[1] 18.79	[1] −.16	[1] 100.87
33-R	246.8	46.6	46.6	18.88	18.88	.00	100.00
Average	238.5	39.8	40.2	16.66	16.83	.17	98.99

CROSSBRED FLEECE SAMPLES.

Lcn. 397	238.4	40.8	[1] 40.7	17.11	[1] 17.07	[1] −0.04	[1] 100.24
Lcn. 507	239.8	53.4	53.7	22.26	22.39	.13	99.44
Rmy. 48	245.0	30.9	32.1	12.61	13.10	.49	96.26
A-24	246.5	47.3	49.4	19.18	20.04	.86	95.74
A-48	237.1	33.6	33.7	14.17	14.21	.04	99.70
A-220	239.4	35.1	36.0	14.66	15.03	.37	97.50
A-295	244.8	25.0	[1] 24.8	10.21	[1] 10.13	[1] −.08	[1] 100.80
A-480	230.2	36.3	37.0	15.76	16.07	.31	98.11
B-335	236.9	28.8	29.0	12.15	12.24	.09	99.31
B-355	216.9	37.2	[1] 37.1	17.15	[1] 17.10	[1] −.05	[1] 100.26
B-545	234.0	29.7	29.7	12.69	12.69	.00	100.00
B-565	220.0	22.6	23.0	10.27	10.45	.28	98.26
C-144	240.5	33.6	34.2	13.97	14.22	.25	98.24
C-157	241.7	23.7	24.4	9.81	10.09	.28	97.13
D-26	238.0	26.8	26.8	11.26	11.26	.00	100.00
E-37	236.4	41.7	45.4	17.63	19.20	1.57	91.85
E-167	235.3	23.0	24.5	9.77	10.41	.64	93.87
O-46	236.6	23.4	23.4	9.89	9.89	.00	100.00
O-96	249.4	30.6	30.7	12.26	12.31	.05	99.67
U. S. 32	253.2	52.4	52.7	20.69	20.81	.12	99.43
Lcn. 439	255.8	26.7	26.7	10.43	10.43	.00	100.00
Lcn. 467	240.7	22.8	22.8	9.47	9.47	.00	100.00
Lcn. 472	237.8	28.9	30.0	12.15	12.61	.46	96.33
Lcn. 475	251.9	27.8	27.9	11.03	11.07	.04	99.64
Cla. 61	237.6	16.4	17.7	6.90	7.44	.54	92.65
A-5	250.0	32.2	32.2	12.88	12.88	.00	100.00
A-70	294.9	37.5	[1] 37.4	12.71	[1] 12.68	[1] −.03	[1] 100.26
B-5	254.8	33.1	33.5	12.99	13.14	.15	98.81
B-352	239.7	34.1	34.1	14.22	14.22	.00	100.00
B-409	181.4	26.3	26.7	14.49	14.71	.22	98.50
B-451	234.2	36.3	36.9	15.49	15.75	.26	98.37
B-579	260.1	31.6	31.6	12.14	12.14	.00	100.00
C-58	239.6	27.3	28.3	11.39	11.81	.42	96.46
C-159	238.0	28.7	30.6	12.05	12.85	.80	93.79
C-191	242.7	23.3	25.3	9.60	10.42	.82	92.09
D-8	241.5	19.3	19.7	7.99	8.15	.16	97.96
E-42	237.7	30.1	30.8	12.66	12.95	.29	97.72
E-165	250.4	16.7	17.5	6.66	6.98	.32	95.42
O-106	235.5	22.2	22.9	9.42	9.72	.30	96.94
U. S. 7	238.1	39.3	39.6	16.51	16.63	.12	99.24
Lcn. 160	240.8	30.3	30.5	12.58	12.66	.08	99.34
Lcn. 388	239.4	24.6	25.1	10.27	10.48	.21	98.01
Lcn. 498	245.3	35.1	35.2	14.31	14.34	.03	99.71
O-70	244.9	33.1	33.8	13.51	13.80	.29	97.92
Cla. 54	261.3	29.9	30.1	11.44	11.51	.07	99.33
Cla. 138	239.6	35.9	37.2	14.98	15.52	.54	96.51
A-68	250.0	32.6	33.2	13.04	13.28	.24	98.19
A-423	254.0	28.8	28.8	11.33	11.33	.00	100.00
A-487	235.3	26.9	28.8	11.43	12.23	.80	93.40
B-28	253.6	28.6	29.9	11.27	11.79	.52	95.65
B-626	239.3	27.1	28.9	11.32	12.07	.75	93.77
B-821	234.9	22.2	22.2	9.45	9.45	.00	100.00
Lst. 21	235.5	21.9	[1] 21.6	9.29	[1] 9.17	[1] −.12	[1] 101.38
D-18	235.1	26.0	27.1	11.05	11.52	.47	95.94
D-24	240.1	31.9	32.4	13.28	13.49	.21	98.45
O-160	248.9	22.1	24.7	8.87	9.92	1.05	89.47
E-21	228.2	35.6	36.6	15.60	16.03	.43	97.26
E-38	236.4	54.6	55.4	23.09	23.43	.34	98.55
U. S. 37	248.5	49.6	50.2	19.95	20.20	.25	98.80
U. S. 159	228.0	14.6	16.4	6.40	7.19	.79	89.02
Average	241.0	30.8	31.5	12.77	13.05	.28	97.84

[1] See footnote [2] under Table 5.

Table 6 shows that the grease removed from the 60 Rambouillet fleece samples by the first three extractions averaged 16.66 per cent of the conditioned weight of the raw wool, while at the fourth extraction the per cent averaged 16.83, or 0.17 per cent removed by the fourth treatment. From the 60 crossbred samples an average of 12.77 per cent of grease was removed by the first three treatments, and 13.05 per cent by four, or 0.28 per cent by the fourth treatment. From the extremely small amount of grease removed by the fourth extraction in each case, it is assumed that the per cent of grease extracted by the four treatments shows the total quantity of grease contained in the samples, and that the per cent removed by the fourth is negligible. Using the figures obtained from the four extractions as the total amount of grease, and therefore as a basis for calculation, Table 6 shows that 98.99 per cent of the total grease was removed by three extractions from the Rambouillet samples and 97.84 per cent from the crossbred. Since these tests show that only a negligible quantity of grease is removed by the fourth extraction, it has been decided to use three gasoline treatments in the scouring process.

DETERMINING WEIGHT OF DIRT.

Before the third conditioning of the wool in the oven, it is necessary to remove all the dirt in order to obtain the clean-wool weight. A part of the dirt is of course removed with the grease by the gasoline treatments. This is caught by the filter papers and kept with the samples until they are ready to be washed in the tub, when the dirty filter papers are thrown away. The rest of the dirt is removed by means of soap and water in the tub, about half a pound of neutral soap proving to be sufficient for the 150 gallons of water used. The temperature of the water is kept at 40° to 45° C., as trials showed that temperature to be sufficient for the removal of the dirt, without being hot enough to felt the wool. After the wool has been washed, rinsed, and dried in blower and oven, the clean weight of the wool is taken. The weight of dirt is determined by subtracting the weight of clean wool from the weight of degreased wool before the removal of the dirt.

WEEKLY WORKING SCHEDULE.

In order to scour all the samples sent to the laboratory each year, it is necessary to complete 60 each week. Owing to the fact that in the process each set of samples must dry after the various treatments—three hours in the conditioning oven at three different times, about three hours between each of the three gasoline treatments, and eight hours in the blower dryer—it is evident that considerable time elapses between the beginning and the completion of the scouring of each run of samples. For example, a run started on Monday will be completed on Friday.

The laboratory is equipped to handle only 20 samples at a time. Consequently it is important that the runs be arranged in such way that they do not conflict in the use of the apparatus, and that all runs will be handled in the same way as nearly as possible. Therefore, in order to obtain uniformity of treatment and the largest possible weekly output, the following schedule has been worked out. It is so

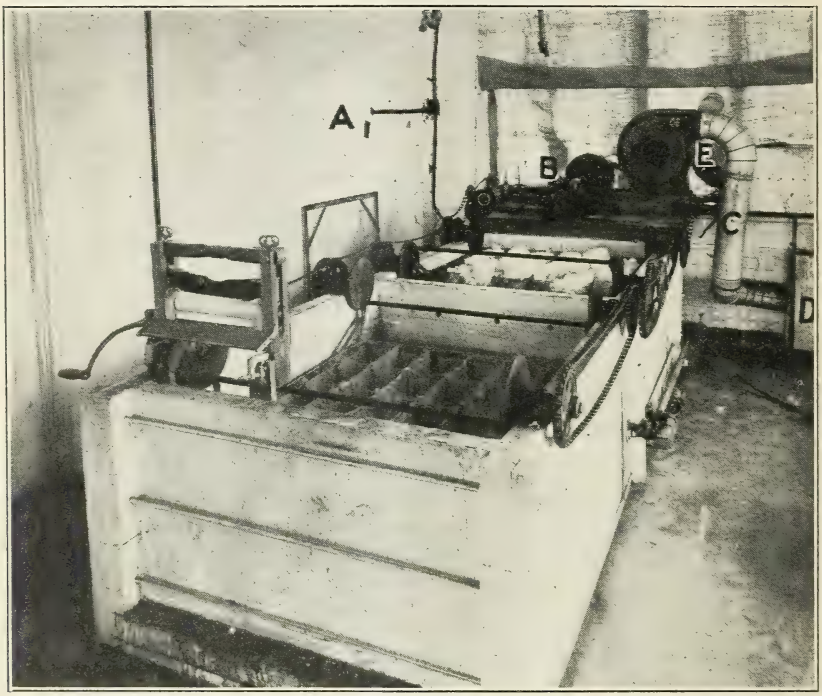

FIG. 5.—Washing apparatus. The empty washing baskets are shown in the first tub and the washing baskets filled with wool in the second tub. When this apparatus is in operation the washing baskets rise, move from end to end, and fall. Note the holes in the partition between the first and second tubs. Water is allowed to rise almost to these holes and is then shut off. In case of an overflow the holes prevent flooding the top. The water is heated by steam pipes in the bottom of each tub. At the right of A is the electric switch button and the motor, B, that drives the washing machinery. The ordinary clothes wringer shown in the foreground is used for wringing water from washed, rinsed wool samples. The air pipe, C, conducts air into tank, D, of the blower-dryer. The heated air returns through the upper part of the blower-dryer, where the baskets of wool are placed for drying, and the air passes out of the dryer through the pipe shown at E.

arranged that it operates in weekly cycles (the work of each day of the week being the same as that of the preceding week). This schedule also has the advantage of rendering possible the picking up of the threads of the process, without delay, in case of change in individual operators in the laboratory.

The different steps outlined below are explained in detail on pages 2, 3, and 4.

Weekly schedule of work at Bureau of Animal Industry Wool Laboratory, Beltsville, Md.

MONDAY.

A. M.
9.00 Place baskets 81–100 in oven empty.
9.25 Weigh baskets 81–100. Take from oven, fill with new wool.
10.00 Put 81–100 in oven for three hours.
10.15 Fold and weigh filter papers.
P. M.
1.00 Weigh baskets 81–100.
4.00 Put gasoline on baskets 81–100.
4.45 Filter.
Blower on all day.

TUESDAY.

A. M.
9.00 Place baskets 21–40 in oven empty.
9.20 Distill gasoline.
9.25 Weigh baskets 21–40. Take from oven, fill with new wool.
10.00 Place baskets 41–60 (clean wool left from preceding week) in oven for three hours.
11.00 Put gasoline on 81–100.
11.45 Filter.
P. M.
1.00 Weigh baskets 41–60.
1.15 Distill gasoline.
1.30 Place baskets 21–40 in oven for three hours.
3.30 Put gasoline on 81–100.
4.15 Filter.
4.30 Weigh 21–40.

WEDNESDAY.

A. M.
9.20 Distill gasoline.
10.00 Place baskets 81–100 in oven for three hours.
10.15 Fold and weigh filter papers.
11.00 Put gasoline on 21–40.
11.45 Filter.
P. M.
1.00 Weigh baskets 81–100.
1.30 Wash 81–100.
2.30 Distill gasoline.
4.00 Put gasoline on 21–40.
4.45 Filter.

THURSDAY.

A. M.
9.00 Place baskets 61–80 in oven empty.
9.20 Distill gasoline.
9.25 Weigh baskets 61–80. Take from oven, put in new wool.
10.00 Place 61–80 in oven for three hours.
10.30 Put gasoline on 21–40.
11.15 Filter.
P. M.
12.00 Place 21–40 in blower for 1¼ hours.
1.00 Weigh 61–80.
1.15 Distill gasoline.
1.30 Place 21–40 in oven three hours.
2.00 Fold and weigh filter papers.
3.30 Put gasoline on 61–80.
4.15 Filter.
4.30 Weigh baskets 21–40.
Blower on all day.

FRIDAY.

A. M.
9.20 Distill gasoline.
10.00 Wash 21–40.
11.00 Put gasoline on 61–80.
11.45 Filter.
P. M.
1.30 Place 81–100 in oven for three hours.
1.30 Distill gasoline.
3.30 Put gasoline on 61–80.
4.15 Filter.
4.30 Weigh 81–100.
Blower on from 12 to 5 o'clock.

SATURDAY.

A. M.
9.20 Distill gasoline.
10.00 Place 61–80 in oven for three hours.
P. M.
1.00 Weigh 61–80.
1.30 Place 21–40 in oven for three hours.
1.30 Wash 61–80 in tub.
4.30 Weigh 21–40.
Blower on till noon.

TABLE 7.—*Sample sheet from record book.*

Page.....

Date, October 11, 1921.

BREED: Rambouillet. 1921 WOOL CLIP.

WOOL-SCOURING DATA.

Basket No.	Sample No.	*a* Conditioned weight of sample and basket.	*b* Weight of basket.	*c* Conditioned weight of greasy wool.	*d* Conditioned weight of wool filter paper and basket after extraction.	*e* Weight of filter paper.	*f* Conditioned weight of wool (after extraction) and dirt.	*g* Weight of grease extracted.	*h* Conditioned weight of wool and basket after washing.	*i* Weight of dirt.	*j* Conditioned weight of clean wool.	*k* Per cent grease.	*l* Per cent dirt.	*m* Per cent clean wool.	*n* Grease index.	*o* Dirt index.
		Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per cent.*	*Per cent.*	*Per cent.*		
21	561	560.5	313.6	246.9	550.6	30.6	206.4	40.5	422.1	97.9	108.5	16.40	39.65	43.94	37.32	90.23
22	1304	542.5	316.4	226.1	523.7	30.8	176.5	49.6	412.6	80.3	96.2	21.93	35.51	42.54	51.55	83.47
23	1318	540.2	317.0	223.2	523.9	30.6	176.3	46.9	417.4	75.9	100.4	21.01	34.01	44.98	46.71	75.59
24	1334	558.8	316.3	242.5	530.4	29.7	214.1	28.4	418.6	111.8	102.3	11.71	46.10	42.18	27.76	109.28
25	1405	556.0	317.8	238.2	553.9	30.4	205.7	32.5	438.1	85.4	120.3	13.64	35.85	50.50	27.01	70.98
26	1416	560.6	320.7	239.9	547.6	30.1	196.8	43.1	453.9	63.6	133.2	17.96	26.51	55.52	32.35	47.74
27	1652	550.6	312.2	238.4	520.7	31.2	177.3	61.1	422.2	67.3	110.0	25.62	28.22	46.14	55.54	61.18
28	1722	554.5	313.8	240.7	531.4	30.5	187.1	53.6	409.5	91.4	95.7	22.26	37.97	39.75	56.01	95.51
29	2092	562.4	324.9	237.5	535.5	30.7	179.9	57.6	427.0	77.8	102.1	24.25	32.75	42.98	56.41	76.19
30	2301	563.8	320.8	243.0	546.6	30.2	195.6	47.4	440.3	76.1	119.5	19.51	31.31	49.17	39.66	63.68
31	2302	541.0	308.7	232.3	525.0	31.3	185.0	47.3	424.2	69.5	115.5	20.36	29.91	49.72	40.95	60.17
32	2332	549.5	307.7	241.8	542.3	29.3	205.3	36.5	437.4	75.6	129.7	15.09	31.26	53.63	28.14	58.28
33	2840	544.5	310.4	234.1	523.4	30.0	183.0	51.1	440.4	53.0	130.0	21.82	22.63	55.53	39.31	40.76
34	2845	566.1	322.2	243.9	554.1	30.2	201.7	42.2	446.6	77.3	124.4	17.30	31.69	51.00	33.92	62.13
35	2860	542.9	304.5	238.4	543.3	30.5	208.3	30.1	423.5	89.3	119.0	12.62	37.45	49.91	25.29	75.04
36	2936	543.2	310.3	232.9	544.7	30.7	203.7	29.2	456.0	58.0	145.7	12.53	24.90	62.55	20.04	39.81
37	3018	557.0	321.2	235.8	554.7	31.1	202.4	33.4	454.6	69.0	133.4	14.16	29.26	56.57	25.03	51.72
38	3032	548.2	313.7	234.5	533.5	30.7	189.1	45.4	433.5	69.3	119.8	19.36	29.55	51.08	37.89	57.84
39	3059	546.1	311.1	235.0	539.3	30.5	197.7	37.3	422.7	86.0	111.7	15.87	36.59	47.53	33.39	76.99
40	3122	550.9	313.2	237.7	535.1	29.6	191.8	45.9	419.2	85.8	106.0	19.31	36.09	44.59	43.30	80.94

EXPLANATION OF WOOL-SCOURING DATA SHEET.

Actual weights taken in the laboratory are recorded as shown in Table 7 in columns *a*, *b*, *d*, *e*, and *h*. All weights of wool shown on data sheet are conditioned weights. The others are filled in from calculations made from *a*, *b*, *d*, *e*, and *h*. The following formulas show the calculation used to obtain the figures of each column.

$a-b=c$	$f-j=i$
$d-(b+e)=f$	$100\ i\div c=l$
$c-f=g$	$100\ j\div c=m$
$h-b=j$	$100\ g\div j=n$
$100\ g\div c=k$	$100\ i\div j=o$

or:

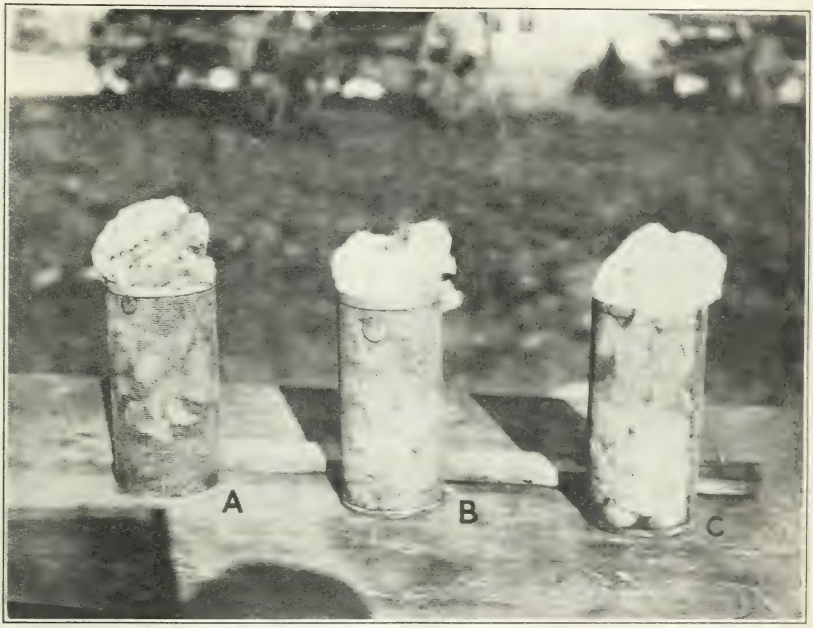

FIG. 6.—Baskets of wool. A, raw wool before scouring. B, degreased wool, dirt remaining. C, clean, scoured wool, free from grease and dirt.

The weight of basket (*b*) subtracted from the conditioned weight of sample and basket (*a*) gives the conditioned weight of greasy wool (*c*).

The weight of basket (*b*) and weight of filter paper (*e*) subtracted from the conditioned weight of wool, filter paper, and basket after extraction (*d*) gives the conditioned weight of wool and dirt after extraction (*f*).

The conditioned weight of greasy wool (*c*) minus the conditioned weight of wool and dirt after extraction (*f*) gives the weight of grease (*g*).

The conditioned weight of wool and basket after washing (*h*) minus the weight of basket (*b*) gives the conditioned weight of clean wool (*j*).

The weight of grease (*g*) divided by the weight of greasy wool (*c*) gives the per cent of grease in the sample (*k*).

The conditioned weight of wool and dirt after extraction (*f*) minus the conditioned weight of clean wool (*j*) gives the weight of dirt (*i*).

The weight of dirt (*i*) × 100 divided by the conditioned weight of greasy sample (*c*) gives the per cent of dirt (*l*).

The weight of clean wool (*j*) × 100 divided by the conditioned weight of the greasy sample (*c*) gives the per cent of clean wool (*m*).

The weight of grease (*g*) × 100 divided by the conditioned weight of clean wool (*j*) gives the grease index (*n*).

The weight of dirt (*i*) × 100 divided by the conditioned weight of clean wool (*j*) gives the dirt index (*o*).

SUMMARY.

Before the scouring process, all samples of wool are brought to a constant-moisture content.

In the moisture experiments here reported, 20 per cent moisture was the largest percentage for any of the samples used.

When there is no more than 20 per cent moisture in air-dry samples, it has not been found necessary to condition them longer than three hours nor at a temperature higher than 50° C.

Grease is removed by washing the samples in gasoline, which is drained off through filter papers in order to retain all foreign matter.

Three gasoline treatments are used in degreasing the wool, since it has been found that only 0.17 per cent of grease remains in Rambouillet wool after three treatments, and 0.28 per cent in crossbred wool.

Dirt is removed from the samples by means of soap and water. A temperature of 40° to 45° C. is used for the water, as trials show that this is sufficient to remove the dirt, without being hot enough to felt the wool.

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